

### The elements of the behaviour

The rigidity of some of the movements in connection with the normal surfacing, together with their presence in sleeping and tranquilized animals (McGORMICK 1969), as well as beached ones (SPENCER et al. 1966) — in the latter case most conspicuously demonstrated by the powerful tailfin upstroke, especially in young animals (pers. obs.) — indicate that these movements are strongly bound together with the breathing, and that they most likely are involuntary.

Not only are they synchronized with the blowhole operation, but they also have to be extremely well timed with the reaching of the surface.

Obviously there are both quite stereotypic movements, i. e. the tailbeats, mixed with orienting ones, taxis', i. e. the dorsal flexure of the thorax and the pectoral fin movements.

The fact that the prevention from steering with the pectoral fins has no effect on the surfacing, indicates that the tailfin movements also includes taxis' (cf the egg-retrieving behaviour in the grey lag goose; LORENZ and TINBERGEN 1938), making possible an adjustment of the tailbeats in relation to the surface.

If the stereotypic movements are innate, they are to be termed fixed motor patterns (originally called Erbkoordinationen by LORENZ 1937). Unfortunately it is not possible from the literature to get a description detailed enough of the surfacing behaviour of the newborn porpoise to be able to conclude what parts are innate and what parts are not.

McBRIDE and KRITZLER (1951), though, report that newborn bottlenose dolphins, *Tursiops truncatus*, do not perform the adult roll when surfacing, until they are 1–2 months old. Instead they raise their whole head above the water at an approximate angle of 45 degrees, and then simply fall back again. Observations on a free-ranging, approximately 2 months old harbour porpoise, indicate that a learning or maturing process takes place at this age, as this juvenile demonstrated both types of surfacing behaviour in the run of a couple of days (AMUNDIN and AMUNDIN in press).

However, complicating the picture are the observations of ANDERSEN (pers. comm.) of a very young, also free-ranging harbour porpoise — its length was only about 70 cm, and it had a pronounced "neck", indicating that it was very close to newborn. In spite of being so young, the little porpoise performed a perfect, species-typic surfacing behaviour.

There are special problems facing a little porpoise at breathing. Firstly the distance from the tip of the snout to the blowhole is much shorter than in the adult, secondly, due to the lesser mass of the little animal, the bow wave in front of the melon, created during the upstroke with the tailfin, is much smaller. Both these factors increase the risk of inhaling water.

Considering the well developed brain in the newborn porpoise, and the skill with which it follows the adults, even at top speed (McBRIDE and KRITZLER 1951; ESSAPIAN 1953; TAVOLGA and ESSAPIAN 1957), it is quite likely that many, if not all, components in the surfacing behaviour are present at birth.

However, due to the abovementioned problems for the smaller animal at surfacing, it may be that some of the taxes, especially the dorsal flexure of the thorax, suppress the downward tendencies, e. g. the downward steering with the pectorals (cf 1.4–2.0 seconds, fig. 3). Such a dominance of the dorsal flexure was seen in a 2 year old Harbour porpoise, which was coughing several times in rapid succession. At the end of the coughing attack, the animal was in a vertical position, with its head above the water (AMUNDIN in press).

## Summary

This study confirms earlier observations of apparently involuntary movements, strongly associated with the breathing. The movements include taxes — a dorsal flexure of the thorax and steering movements with the pectoral fins — and a more stereotypic movements, resembling a fixed motor pattern, with the tailfin. In the latter, a downstroke is paired with the expiration, and a powerful, thrust producing upstroke with the inhalation.

The different components are beautifully coordinated into a smooth and highly functional sequence of movements, ensuring that the blowhole is raised above the water at the breathing. Many of the movements are present in sleeping, tranquilized, and beached animals, thereby giving an indicator of the strength of association with the breathing.

The duration of an expiration and an inhalation was measured for a couple of blows, and was found to be 0.4 and 0.8 seconds respectively.

## Zusammenfassung

*Funktionelle Analyse des Auftauch-Verhaltens bei Phocoena phocoena (L.)*

Diese Studie bestätigt frühere Beobachtungen von offenbar unfreiwilligen Bewegungen, die mit der Atmung stark verbunden sind. Die Bewegungen beinhalten Taxien — eine Dorsalbeugung des Thorax und Steuerbewegungen mit den Brustflossen — und einige stereotypere Bewegungen mit der Schwanzflosse, die einem „fixed motor pattern“ gleichen. Im letzten Fall ist ein abwärtiger Stoß mit der Ausatmung verbunden, und ein kräftiger, Treibkraft produzierender Stoß führt durch Einatmung aufwärts.

Die verschiedenen Komponenten sind schön koordiniert, in einer Reihe von gleichmäßigen und sehr funktionellen Bewegungen, die sichern, daß das Luftloch während der Atmung über dem Wasser ist. Viele der Bewegungen sind während des Schlafs, der Betäubung und auch bei gestrandeten Tieren zu beobachten, und es wird daraus die Verbindung zwischen Atmung und Bewegung deutlich. Die Dauer der Ein- und Ausatmung ist einige Male gemessen worden. Sie betrug 0,4 und 0,8 Sekunden.

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